

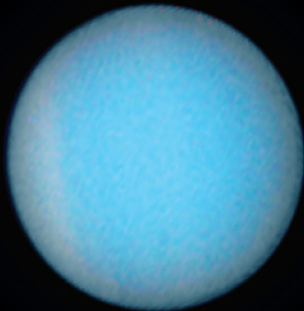
Jupiter



Saturn



Uranus



Neptune



The Jovian Planets

Images are not to scale

The Jovian Planets

These images of the four Jovian planets — Jupiter, Saturn, Uranus, and Neptune — hint at some of the remarkable attributes that set them apart from the smaller, rocky terrestrial planets. Also called “giant planets,” the Jovian planets occupy orbits in the outer solar system at distances ranging from 5 (Jupiter) to 30 (Neptune) times the Earth’s distance from the Sun.

Unlike the terrestrial planets that make up our inner solar system — Mercury, Venus, Earth, and Mars — the Jovian planets do not have solid surfaces. Instead, they are composed primarily of hydrogen and helium, with traces of methane, ammonia, water, and other gases in their atmospheres. These gases make up a deep atmosphere and become tightly compressed around relatively tiny cores of rock. At great depths within Jupiter, for example, the hydrogen gas is compacted so tightly that it exists in a rare metallic form.

Each of the Jovian planets has several characteristics in common. While Saturn’s bright rings are the most visible and well known, fainter and darker rings have been seen around Jupiter, Uranus, and Neptune. The Jovian planets also are distinctive for having many moons. Saturn and Jupiter each have more than 60 moons, Uranus has more than 20, and Neptune has more than 10. The planets also have fierce winds and storms, and a rapid rotation.

When compared to Earth, the Jovian planets are enormous. Jupiter is 11 times larger than Earth in diameter and is the biggest planet in our solar system. Saturn is the next largest, at nine times bigger than Earth. Uranus and Neptune are both roughly four times larger than Earth. Despite their size, the Jovian planets have low densities because of their gaseous composition. Saturn, for example, is made of materials lighter than water. If it could be placed in a giant swimming pool, the planet would float.

The Jovian planets’ colors differ due to their temperature, composition, and cloud height. For example, the brown clouds on Jupiter are deeper in the atmosphere than the planet’s white ammonia clouds. Neptune’s pink-white methane ice clouds are higher in the atmosphere than its blue gaseous atmosphere.

Surprisingly, it is the trace gases in the Jovian atmospheres — not the hydrogen or helium — that give the planets’ clouds their color. For example, Uranus and Neptune are blue-green because they have a small amount of methane in their upper atmospheres.

VOCABULARY

Density: The amount of mass per volume in an object or region of space.

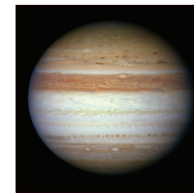
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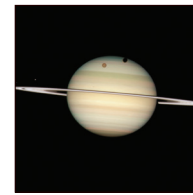
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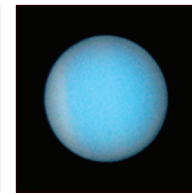
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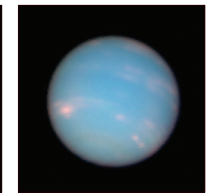
Jupiter–2010



Saturn–2009



Uranus–2007



Neptune–2011

The Jovian Planets:

These images show the four Jovian planets. In the image of Jupiter, the planet’s strong winds blowing east to west create the banded structure in the atmosphere. The Saturn image shows the shadow of the moon Mimas and the planet’s magnificent ring system. In the image of Uranus, methane gas in the atmosphere gives the planet its blue-green color. The clouds in Neptune’s atmosphere are made up of methane ice crystals, which appear pink in the image because they are reflecting near-infrared light. The images of Jupiter and Neptune were taken with the Wide Field Camera 3. The images of Saturn and Uranus were made with the Wide Field Planetary Camera 2.

Image Credits: Jupiter: M.H. Wong (University of California, Berkeley)

Saturn and Neptune: Hubble Heritage; Uranus: M. Showalter (SETI Institute)

Fast Facts

	Diameter		Distance from the Sun	
	Miles	Kilometers	Miles	Kilometers
Earth	7,926	12,756	9.296×10^7	1.496×10^8
Jupiter	88,850	142,984	4.836×10^8	7.783×10^8
Saturn	74,900	120,536	8.882×10^8	1.429×10^9
Uranus	31,760	51,118	1.784×10^9	2.871×10^9
Neptune	30,775	49,528	2.799×10^9	4.504×10^9

You can get images and other information about the Hubble Space Telescope on the World Wide Web. Visit our website, <http://hubblesite.org/>, and follow the links.

The corresponding classroom activity for this lithograph can be found at: <http://amazing-space.stsci.edu/eds/tools/type/pictures.php> or may be obtained by contacting the Office of Public Outreach at the Space Telescope Science Institute, 3700 San Martin Drive, Baltimore, MD 21218.





In Search of ... Jovian Planets

Description

Use the “Jovian Planets” lithograph as the initial source of information to engage your students in a Level One Inquiry Activity. Students will use the images and text on this lithograph to generate questions about a group of planets in the solar system. They will conduct research to answer their questions. This curriculum support tool is designed to be used as an introductory activity in a unit that incorporates scientific inquiry or that has a solar system theme.

About Inquiry-based Learning

The inquiry process is driven by a student’s own curiosity, wonder, interest, or passion to understand an observation or to solve a problem. It involves a process of exploring the natural or material world. This exploration prompts students to ask questions and to make discoveries in the search for new insights. A Level One Inquiry Activity uses questions and problem-solving methods directed by the teacher. In this activity, teachers will use the lithograph images to help students formulate questions about planets in the solar system. Teachers will suggest selected resources about the planets to help students answer their questions. Students will provide supporting evidence for their conclusions. This process can help prepare students to become more independent thinkers.

Grade Level

Grades 8-10

Prerequisites

Students should know that there are eight planets in the solar system.

Misconceptions

Teachers should be aware of the following common misconceptions and should determine whether their students harbor any of them. Students may have misconceptions regarding the makeup of the solar system. Some students may think that the Earth is the center of the solar system. Others may think that stars and galaxies outside the solar system are part of the solar system. In addition, students may think that spacecraft can land on the Jovian planets.

Vocabulary

These are terms students may encounter while doing further research on the planets in the solar system:

Jovian planets: The outer planets of our solar system: Jupiter, Saturn, Uranus, and Neptune. Because these planets have similar characteristics, they were named after their mythological namesake Jupiter, which is also known as Jove.

Terrestrial planets: The inner planets of our solar system: Mercury, Venus, Earth, and Mars. Because these planets have similar characteristics, they were named after the planet Earth, whose Latin name is Terra.

See the lithograph for additional vocabulary terms.

Purpose

The purpose of this activity is to engage students in a Level One Inquiry Activity with astronomical images and information. Students will gain experience using the Internet to search for information. They will practice the process skills of observing and analyzing. Students also will organize their material, present their findings, and reflect on what they have learned.

Materials

- “Jovian Planets” lithograph.
- Computer with Internet connection for conducting research.

Instructions for the Teacher

Preparation

- Obtain copies of the lithograph for each student. The “Jovian Planets” lithograph can be found at <http://amazing-space.stsci.edu/capture/solarsyst/preview-jovian.php>.
- Preview the Overview page, found at: <http://amazing-space.stsci.edu/eds/overviews/print/lithos/jovian.php>. Use the “Related Materials” section to (1) become familiar with inquiry-based learning and/or (2) become familiar with the solar system.
- Bookmark or identify as favorites the following suggested websites:
 - Amazing Space Graphic Organizer: “Comparison of rocky and gas planets.” (Use the student version as a learning tool.) http://amazing-space.stsci.edu/resources/organizers/rock_v_gasplanets.php
 - Amazing Space: Fast Facts for solar system objects. <http://amazing-space.stsci.edu/capture/solarsyst/dig.php>

In Search of ... Jovian Planets

- Amazing Space: The Star Witness archive, which contains all past articles. <http://amazing-space.stsci.edu/news/archive/>
- STScI: The News Center archive, which contains articles about solar system members. <http://hubblesite.org/newscenter/archive/releases/solar-system/>

Procedure

Before beginning this activity, identify your students' misconceptions about the solar system by having them write down anything they know and understand about this topic. Use those statements to evaluate your students' misconceptions. Have students volunteer their ideas about the solar system. From those ideas, identify their misconceptions and discuss them with the class. An alternative method is to collect your students' written ideas about the solar system. From those ideas, compile a list of their misconceptions and discuss them with the class.

Ask students to study the images on the front and the back of the lithograph. Then tell your students to write as many questions as they can about the features visible in the images. Collect the questions and group them by common themes. Ask students to read the information on the back of the lithograph. Then ask them if they found the answers to any of their questions. Tell students to use the Internet to research their questions. The Internet sites listed in the "Preparation" section provide a starting point for their research. Tell students how to access other websites.

Ask students to prepare presentations that include answers to their questions. Their presentations also should address the similarities and differences of Jovian and terrestrial planets. This presentation can be in the form of a skit, a story, a graphic organizer, a PowerPoint show, or a written report — any method that conveys a student's understanding of the topic to another student, to a group of students, or to the entire class. Students may work individually or in groups. Ask students to check whether their original questions were answered during their research or from talking with other students. Then ask students if they have any additional questions.

National Aeronautics and Space Administration

Goddard Space Flight Center

8800 Greenbelt Road
Greenbelt, Maryland 20771

www.nasa.gov

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Instructions for the Student

Your teacher will ask you to write down what you know and understand about the solar system. You may be asked to share this information with the rest of the class. Study the images on the front and the back of the lithograph. Write down as many questions as you can about what you see in the images. Read the back of the lithograph to find answers to your questions.

Using your questions as a guide, conduct research on the Internet to find the answers to your questions. Your teacher will provide websites to use for your research. Your teacher also will ask you to create a presentation to demonstrate your understanding of the material you collected through your research. The presentation could be a skit, a story, a graphic organizer, a PowerPoint show, or whatever format that will communicate the information you learned about the solar system. Your teacher will direct you to work individually or in small groups. You may be instructed to make your presentation to another student, to a group of students, or to the entire class.

Education Standards

AAAS Benchmarks: Project 2061

<http://www.project2061.org/publications/bsl/online/bolintro.htm>

4. The Physical Setting

A. The Universe

By the end of the 8th grade, students should know that:

- Nine planets* of very different size, composition, and surface features move around the sun in nearly circular orbits. Some planets have a variety of moons and even flat rings of rock and ice particles orbiting around them. Some of these planets and moons show evidence of geologic activity. The earth is orbited by one moon, many artificial satellites, and debris.

By the end of the 12th grade, students should know that:

- As the earth and other planets formed, the heavier elements fell to their centers. On planets close to the sun (Mercury, Venus, Earth, and Mars), the lightest elements were mostly blown or boiled away by radiation from the newly formed sun; on the outer planets (Jupiter, Saturn, Uranus, Neptune, and Pluto*), the lighter elements still surround them as deep atmospheres of gas or as frozen solid layers.

*The benchmarks were written prior to the reclassification of Pluto as a minor planet. We have chosen to quote the benchmarks as originally published.

Educational Product

Educators & Students

Grades 8–10